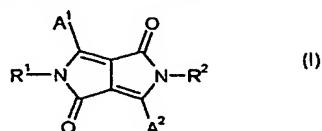


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Claims

1. A fluorescent diketopyrrolopyrrole of the formula I



, wherein

- 5 R¹ and R² may be the same or different and are selected from a C₁-C₂₅alkyl group, which can be substituted by fluorine, chlorine or bromine, an allyl group, which can be substituted one to three times with C₁-C₄alkyl, a cycloalkyl group, a cycloalkyl group, which can be condensed one or two times by phenyl which can be substituted one to three times with C₁-C₄alkyl, halogen, nitro or cyano, an alkenyl group, a cycloalkenyl group, an alkynyl group, a haloalkyl group, a haloalkenyl group, a haloalkynyl group, a ketone or aldehyde group, an ester group, a carbamoyl group, a ketone group, a silyl group, a siloxanyl group, A³ or -CR³R⁴-(CH₂)_m-A³ wherein R³ and R⁴ independently from each other stand for hydrogen or C₁-C₄alkyl, or phenyl which can be substituted one to three times with C₁-C₄alkyl,
- 10 15 A³ stands for aryl or heteroaryl, in particular phenyl or 1- or 2-naphthyl which can be substituted one to three times with C₁-C₈alkyl and/or C₁-C₈alkoxy, and m stands for 0, 1, 2, 3 or 4.
- 15 A¹ and A² are independently of each other a group comprising a five-membered heterocyclic ring, containing one to three heteroatoms selected from the group of nitrogen, oxygen and sulfur, or a six-membered heterocyclic ring, containing one to three heteroatoms selected from the group of nitrogen, oxygen and sulfur, wherein, if
- 20 25 A¹ and A² are a single five- or six-membered heterocyclic ring of formula



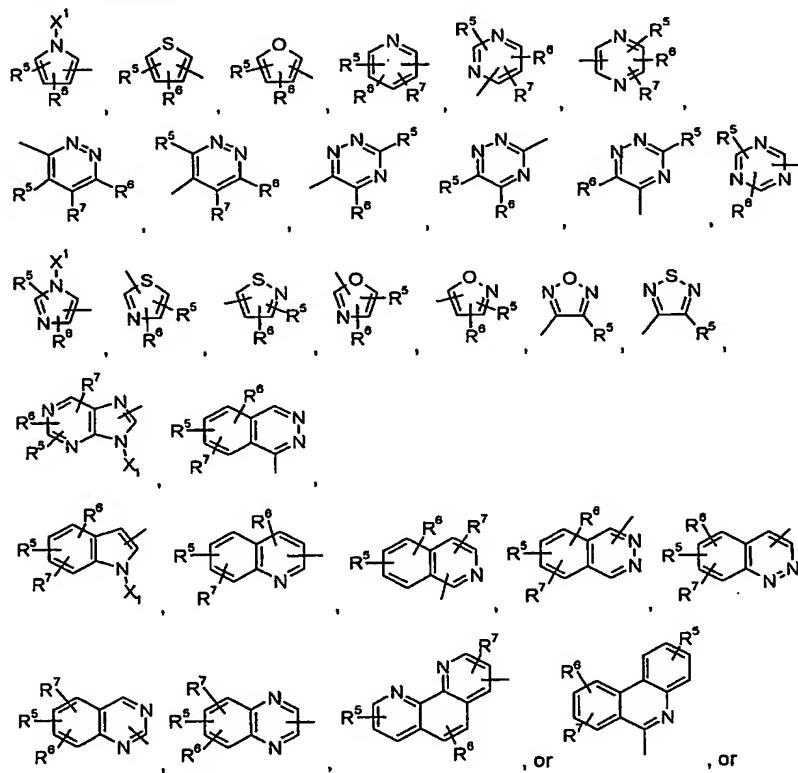
, said heterocyclic ring is substituted by at least a group selected from a C₁-C₂₅alkyl group, a cycloalkyl group, an aralkyl group, an alkenyl group, a cycloalkenyl group, an alkynyl group, a hydroxyl group, a mercapto group, an alkoxy group, an alkylthio group, an aryl ether group, an aryl thioether group, an aryl group, a heterocyclic group, a halogen atom, a haloalkyl group, a haloalkenyl group, a haloalkynyl group, a cyano group, an aldehyde group, a carboxyl group, an ester group, a carbamoyl group, an amino group, a nitro group, a silyl group, a siloxanyl group, a

- 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 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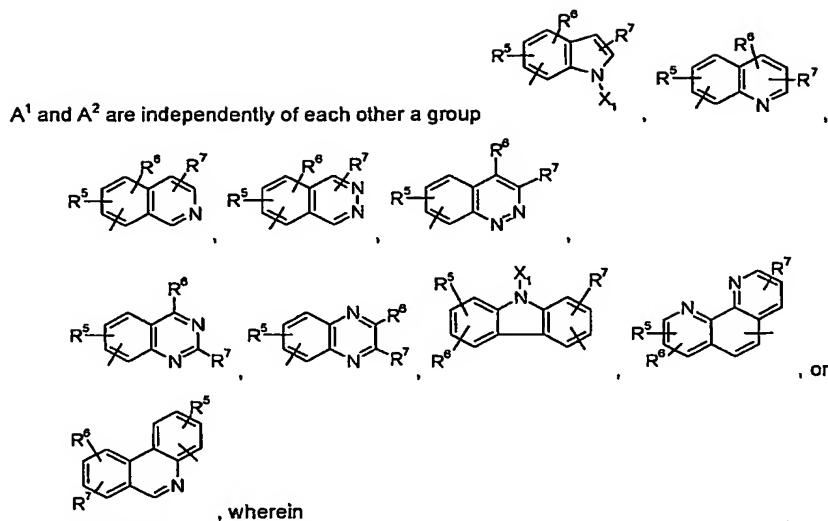
substituted or unsubstituted vinyl group, a group NR^8R^9 , wherein R^8 and R^9 independently of each other stand for a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group, a heteroaryl group, a heterocyclic group, an aralkyl group, or R^8 and R^9 together with the nitrogen atom to which they are bonded form a five or six membered heterocyclic ring, which can be condensed by one or two optionally substituted phenyl groups, wherein the heterocyclic ring is directly bonded to the DPP basis unit, especially

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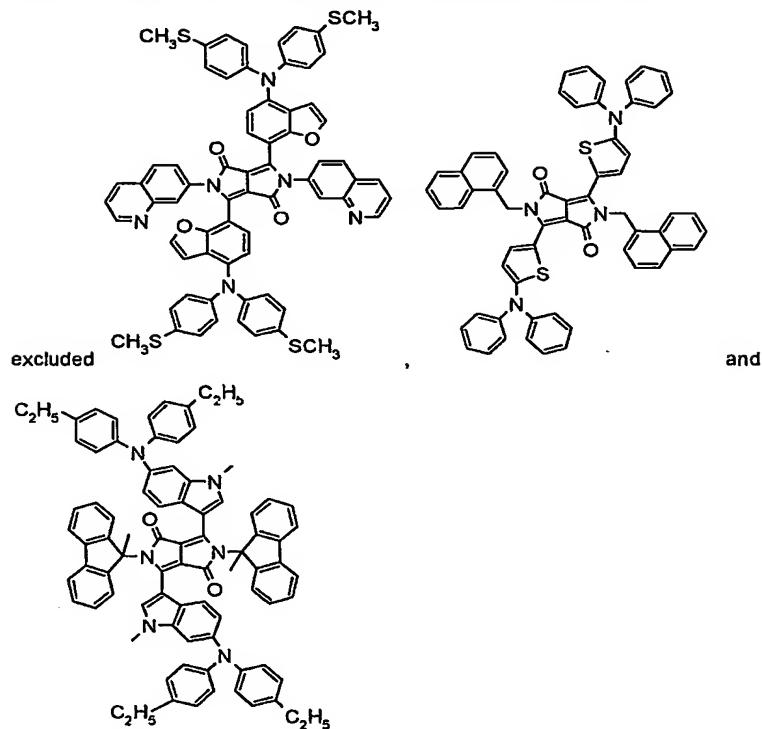
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- 5 R⁵, R⁶, and R⁷ may be the same or different and are selected from a hydrogen atom, a C₁-C₂₅alkyl group, a cycloalkyl group, an aralkyl group, an alkenyl group, a cycloalkenyl group, an alkynyl group, a hydroxyl group, a mercapto group, an alkoxy group, an alkylthio group, an aryl ether group, an aryl thioether group, an aryl group, a heterocyclic group, a halogen atom, a haloalkyl group, a haloalkenyl group, a haloalkynyl group, a cyano group, an aldehyde group, a carboxyl group, an ester group, a carbamoyl group, a nitro group, a silyl group, a siloxanyl group, a substituted or unsubstituted vinyl group, a group NR⁸R⁹, wherein R⁸ and R⁹ independently of each other stand for a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group, a heteroaryl group, a heterocyclic group, an aralkyl group, or R⁸ and R⁹ together with the nitrogen atom to which they are bonded form a five or six membered heterocyclic ring, which can be condensed by one or two optionally substituted phenyl groups, or at least two adjacent substituents R⁵ to R⁷ form an aromatic or aliphatic fused ring system, and
- 10 X¹ is a hydrogen atom, a C₁-C₂₅alkyl group, a cycloalkyl group, an aralkyl group, an aryl group, or a heterocyclic group, wherein at least one of the groups R⁵, R⁶, and R⁷ is different from a hydrogen atom, if A¹ and A² are a single five- or six-membered heterocyclic ring, containing one heteroatom selected from the group of nitrogen,
- 15 wherein
- 20 20

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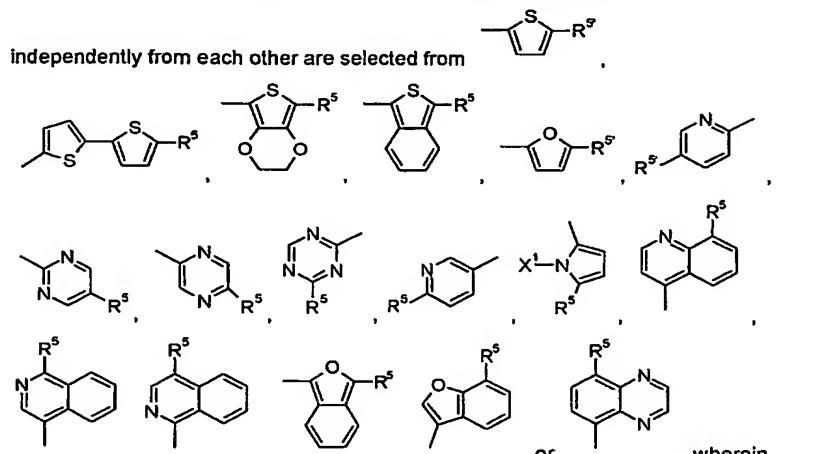
oxygen and sulfur, with the proviso, that the following compounds are



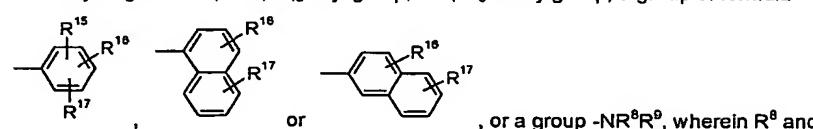
- 5 2. A fluorescent diketopyrrolopyrrole according to claim 1, wherein R¹ and R²
 independently from each other are selected from C₁-C₈alkyl, C₅-C₁₂-cycloalkyl, which
 can be substituted one to three times with C₁-C₈alkyl and/or C₁-C₈alkoxy, or C₅-C₁₂-
 cycloalkyl, which can be condensed one or two times by phenyl which can be
 substituted one to three times with C₁-C₄-alkyl, halogen, nitro or cyano, phenyl or 1- or
 10 2-naphthyl which can be substituted one to three times with C₁-C₈alkyl and/or C₁-
 C₈alkoxy, or -CR³R⁴-(CH₂)_m-A³ wherein R³ and R⁴ stand for hydrogen, A³ stands for
 phenyl or 1- or 2-naphthyl, which can be substituted one to three times with C₁-C₈alkyl
 and/or C₁-C₈alkoxy, and m stands for 0 or 1.

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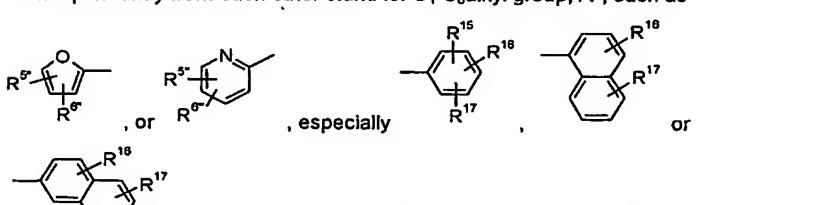
3. A fluorescent diketopyrrolopyrrole according to claim 1, wherein A¹ and A²



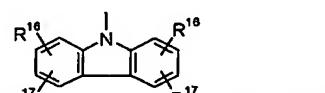
R^5 is a hydrogen atom, a C_1 - C_{12} alkyl group, a C_1 - C_8 alkoxy group, a group of formula



R^9 independently from each other stand for $C_1\text{--}C_{10}$ alkyl group, A^1 , such as $\text{R}^1\text{--}\text{C}_6\text{H}_4\text{--}R^2$



, or R⁸ and R⁹ together with the nitrogen atom to which they are bonded form a five or six membered heterocyclic ring which can be condensed by one

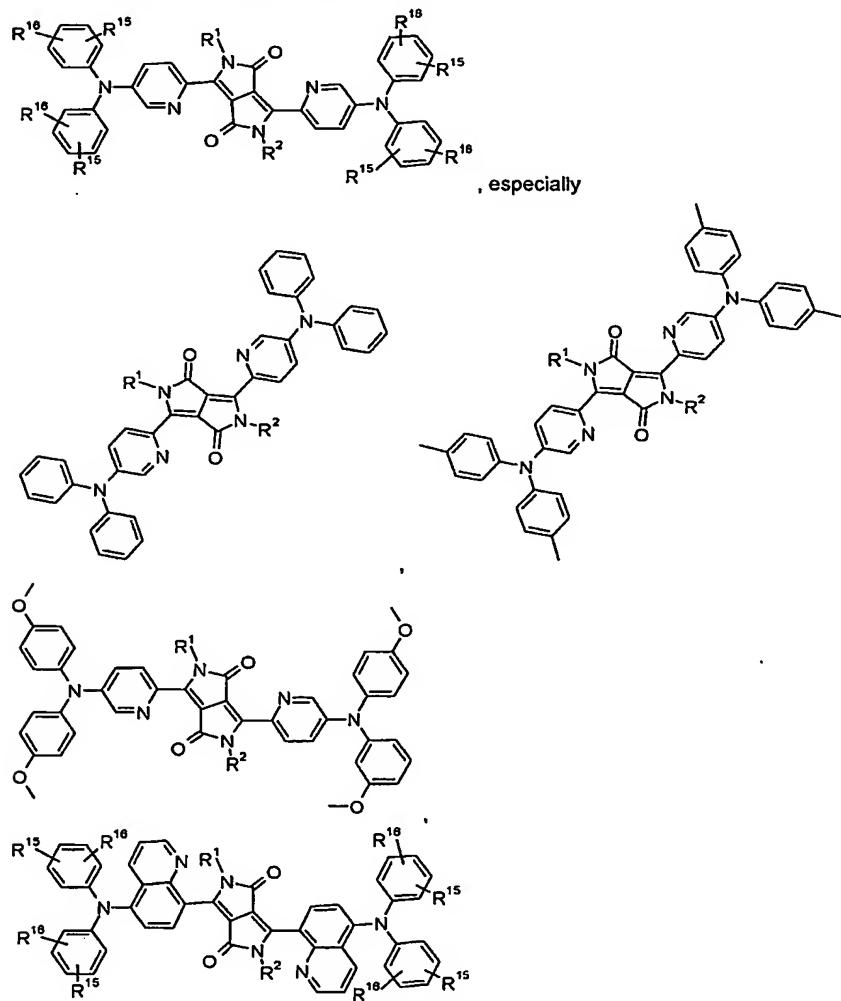


or two optionally substituted phenyl groups, such as R^{17} , wherein R^{15} , R^{16} and R^{17} independently from each other stands for hydrogen, C₁-C₆-alkyl, C₁-C₆-

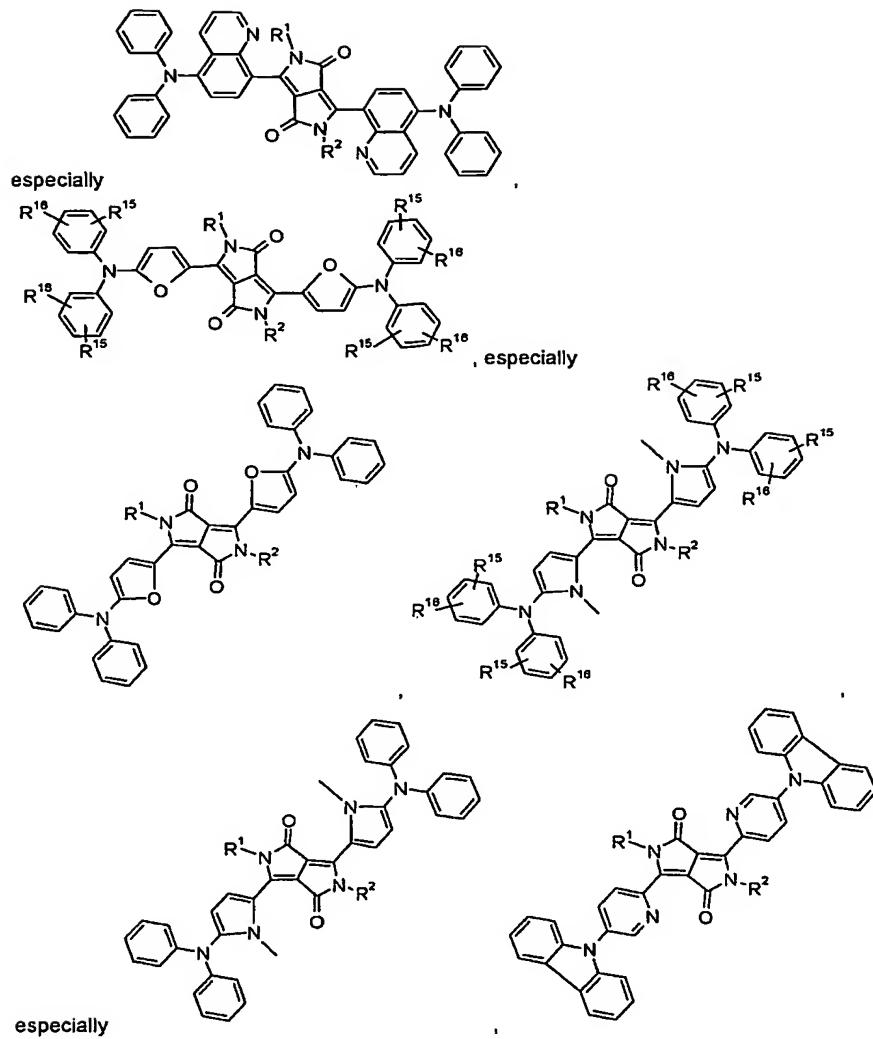
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alkoxy, or phenyl, R^{5'} is R⁵, except hydrogen, R^{5'} and R^{6'} independently from each other stands for hydrogen, C₁-C₈-alkyl or C₁-C₈-alkoxy, and X¹ stands for hydrogen, or C₁-C₈-alkyl.

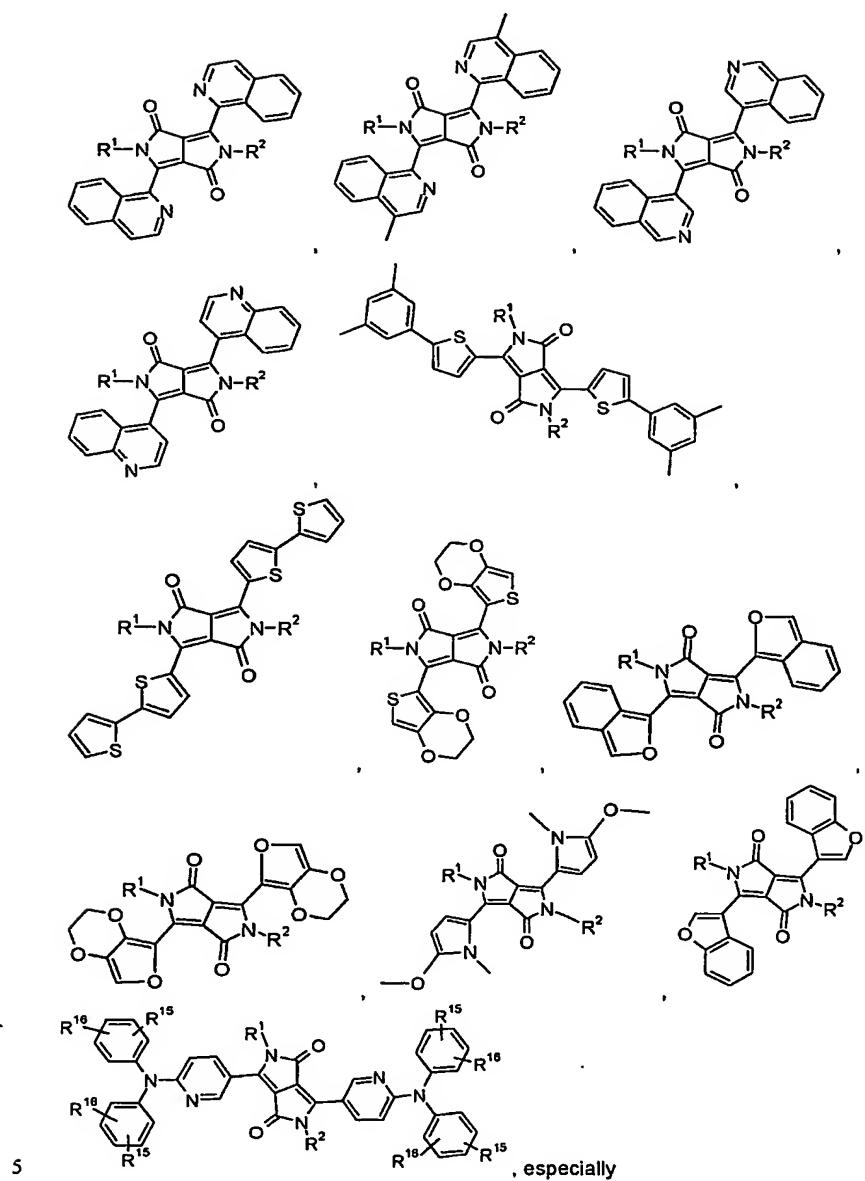
5 4. A fluorescent diketopyrrolopyrrole according to claim 3, which is



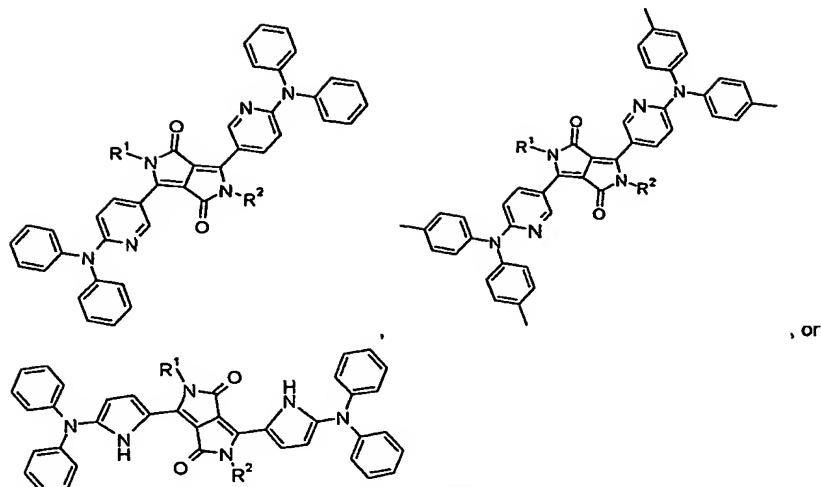
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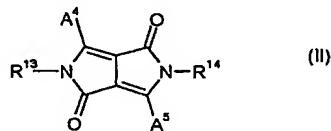
R^1 and R^2 are independently of each other a C₁-C₁₂alkyl group, such as methyl, ethyl, n-propyl, isopropyl, n-butyl, sec.-butyl, isobutyl, tert.-butyl, n-pentyl, 2-pentyl, 3-pentyl, 2,2-dimethylpropyl, n-hexyl, n-heptyl, n-octyl, 1,1,3,3-tetramethylbutyl and 2-ethylhexyl, n-nonyl, n-decyl, n-undecyl, n-dodecyl, a C₅-C₇cycloalkyl group, which optionally can be substituted by one to three C₁-C₈alkyl or C₁-C₈alkoxy groups, a C₅-C₇cycloalkyl group, which can be substituted one to three times with C₁-C₈alkyl and/or C₁-C₈alkoxy, or which can be condensed one or two times by optionally substituted phenyl, or a C₇-C₁₄aralkyl group, which optionally can be substituted by one to three C₁-C₈alkyl or C₁-C₈alkoxy groups, and R^{15} and R^{16} stands for hydrogen, C₁-C₈alkyl, C₁-C₈alkoxy, or phenyl.

- 5. A composition comprising a guest chromophore and a host chromophore, wherein the absorption spectrum of the guest chromophore overlaps with the fluorescence emission spectrum of the host chromophore, wherein the host chromophore is a diketopyrrolopyrrole having a photoluminescence emission peak at 500 to 720 nm, preferably 520 to 630 nm, most preferred 540 to 600 nm and wherein the host chromophore and/or the guest chromophore is a diketopyrrolopyrrole of formula I according to any of claims 1 to 4.
- 15. A composition comprising a guest chromophore and a host chromophore, wherein the absorption spectrum of the guest chromophore overlaps with the fluorescence emission
- 20. A composition comprising a guest chromophore and a host chromophore, wherein the absorption spectrum of the guest chromophore overlaps with the fluorescence emission

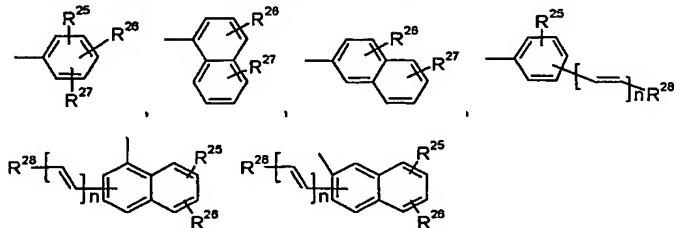
spectrum of the host chromophore, wherein the host chromophore is a diketopyrrolopyrrole having a photoluminescence emission peak at 500 to 720 nm, preferably 520 to 630 nm, most preferred 540 to 600 nm and wherein the guest chromophore is a diketopyrrolopyrrole of formula I according to any of claims 1 to 5.

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7. A composition according to claim 6, wherein the host chromophore is a diketopyrrolopyrrole ("DPP") represented by formula II

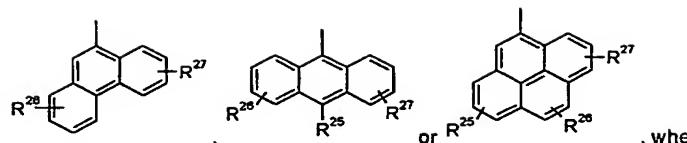


wherein R¹³ and R¹⁴ independently from each other stand for C₁-C₂₅-alkyl, which can be substituted by fluorine, chlorine or bromine, C₅-C₁₂-cycloalkyl or C₅-C₁₂-cycloalkyl, which can be condensed one or two times by phenyl which can be substituted one to three times with C₁-C₄-alkyl, halogen, nitro or cyano, silyl, A⁶ or -CR¹¹R¹²-(CH₂)_mA⁶, wherein R¹¹ and R¹² independently from each other stand for hydrogen, fluorine, chlorine, bromine, cyano or C₁-C₄alkyl, which can be substituted by fluorine, chlorine or bromine, or phenyl which can be substituted one to three times with C₁-C₄alkyl, A⁶ stands for phenyl or 1- or 2-naphthyl which can be substituted one to three times with C₁-C₈alkyl, C₁-C₈alkoxy, halogen, nitro, cyano, phenyl, which can be substituted with C₁-C₈alkyl or C₁-C₈alkoxy one to three times, -NR²³R²⁴, wherein R²³ and R²⁴ represent hydrogen, C₁-C₂₅-alkyl, C₅-C₁₂-cycloalkyl or C₅-C₂₄-aryl, in particular phenyl or 1- or 2-naphthyl which can be substituted one to three times with C₁-C₈alkyl, C₁-C₈alkoxy, halogen or cyano, or phenyl, which can be substituted with C₁-C₈alkyl or C₁-C₈alkoxy one to three times, and m stands for 0, 1, 2, 3 or 4, A⁴ and A⁵ independently from each other stand for



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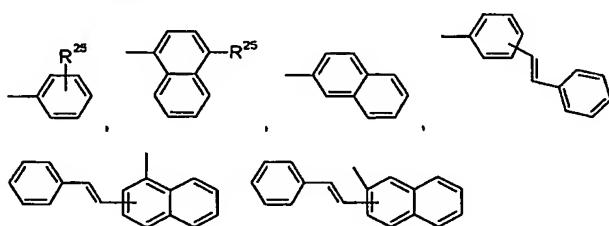


, wherein

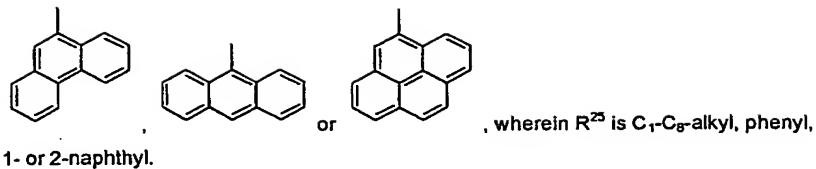
R²⁵, R²⁶, R²⁷ independently from each other stands for hydrogen, C₁-C₂₅alkyl, -CR¹¹R¹²-(CH₂)_m-A⁶, cyano, halogen, -OR²⁹, -S(O)_pR³⁰, or phenyl, which can be substituted one to three times with C₁-C₆alkyl or C₁-C₆alkoxy, wherein R²⁹ stands for C₁-C₂₅-alkyl, C₅-C₁₂-cycloalkyl, -CR¹¹R¹²-(CH₂)_m-Ph, C₆-C₂₄-aryl, or a saturated or unsaturated

5 heterocyclic radical comprising five to seven ring atoms, wherein the ring consists of carbon atoms and one to three hetero atoms selected from the group consisting of nitrogen, oxygen and sulfur, R³⁰ stands for C₁-C₂₅-alkyl, C₅-C₁₂-cycloalkyl, -CR¹¹R¹²-(CH₂)_m-Ph, R²⁸ stands for C₂-C₂₀-heteroaryl or C₆-C₂₄-aryl, p stands for 0, 1, 2 or 3, m and n stands for 0, 1, 2, 3 or 4.

- 10
8. A composition according to claim 6 or 7, wherein R¹³ and R¹⁴ independently from each other stand for C₁-C₆alkyl, C₅-C₁₂-cycloalkyl, which can be substituted one to three times with C₁-C₆alkyl and/or C₁-C₆alkoxy, phenyl or 1- or 2-naphthyl which can be substituted one to three times with C₁-C₆alkyl and/or C₁-C₆alkoxy, or -CR¹¹R¹²-(CH₂)_m-A⁶ wherein R¹¹ and R¹² stand for hydrogen, or C₁-C₄alkyl, A⁶ stands for phenyl or 1- or 2-naphthyl, which can be substituted one to three times with C₁-C₆alkyl and/or C₁-C₆alkoxy, and m stands for 0 or 1.
- 15
- 20 9. A composition according to any of claims 6 to 8, wherein A⁴ and A⁵ independently from each other stand for



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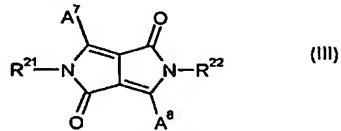


, wherein R²³ is C₁-C₈-alkyl, phenyl,

1- or 2-naphthyl.

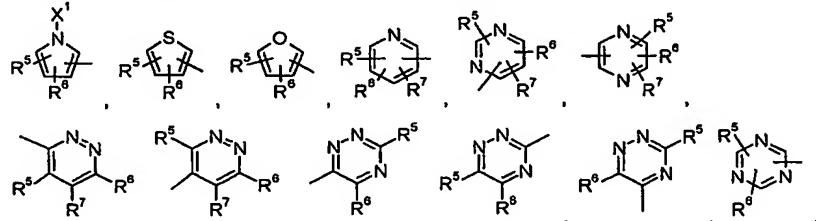
10. An EL device comprising a fluorescent diketopyrrolopyrrole according to any of claims 1
5 to 4 or a composition according to any of claims 5 to 9.

11. A diketopyrrolopyrrole of formula III

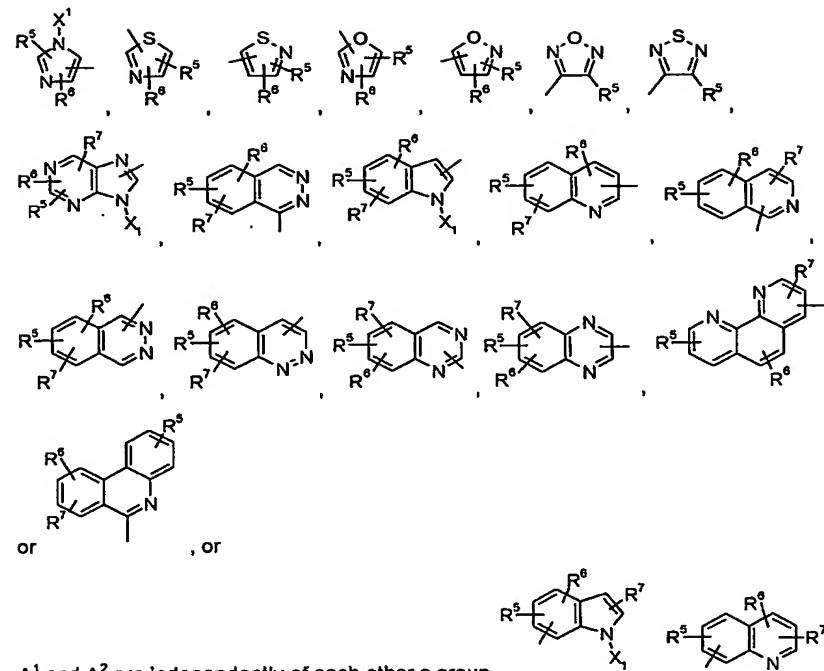
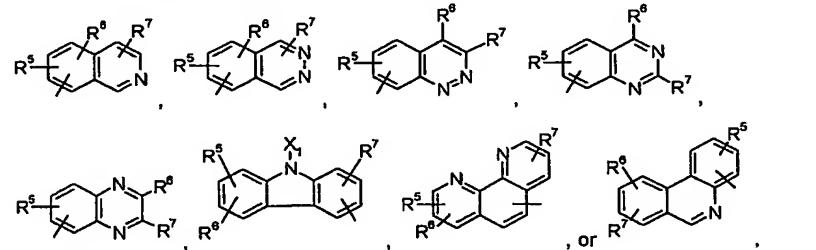


, wherein

10 R²¹ and R²² may be the same or different and are selected from a C₁-C₂₅alkyl group, an
allyl group, which can be substituted one to three times with C₁-C₄alkyl, a cycloalkyl
group, a cycloalkyl group, which can be condensed one or two times by phenyl which
can be substituted one to three times with C₁-C₄alkyl, halogen, nitro or cyano, an
alkenyl group, a cycloalkenyl group, an alkynyl group, a haloalkyl group, a haloalkenyl
group, a haloalkynyl group, a ketone or aldehyde group, an ester group, a carbamoyl
group, a ketone group, a silyl group, a siloxanyl group, A³ or -CR³R⁴-(CH₂)_m-A³ wherein
R³ and R⁴ independently from each other stand for hydrogen or C₁-C₄alkyl, or phenyl
which can be substituted one to three times with C₁-C₄alkyl,
15 A³ stands for aryl or heteroaryl, in particular phenyl or 1- or 2-naphthyl which can be
substituted one to three times with C₁-C₈alkyl and/or C₁-C₈alkoxy, and m stands for 0, 1,
2, 3 or 4,
20 A⁷ and A⁸ independently from each other are selected from



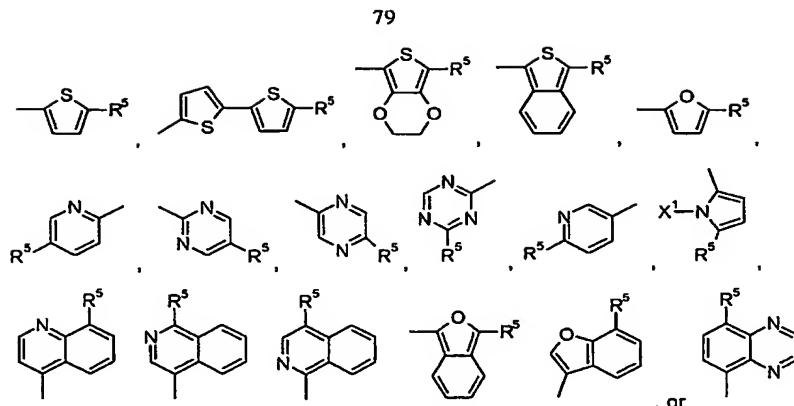
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5 A¹ and A² are independently of each other a group

wherein

wherein one of R⁵, R⁶ and R⁷ is a halogen atom, like a chlorine atom, a bromine atom10 or a iodine atom, and the others are as defined in claim 1 and X¹ is as defined in claim 1.

12. A diketopyrrolopyrrole of formula III according to claim 11, wherein A⁷ and A⁸ independently from each other are selected from



wherein R⁵ is a chlorine atom or a bromine atom and X¹ is as defined in claim 1.

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13. Composition comprising

(a) 0.01 to 50% weight, based on the total weight of the colored high molecular weight organic material, of a fluorescent diketopyrrolopyrrole according to any of claims 1 to 4 or a composition according to any of claims 5 to 9,

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(b) 99.99 to 50% by weight, based on the total weight of the colored high molecular weight organic material, of a high molecular weight organic material, and
(c) if desired, customary additives in effective amounts.

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14. Use of the fluorescent diketopyrrolopyrrole according to any of claims 1 to 4 or a composition according to any of claims 5 to 9 for coloring a high molecular weight organic material, as fluorescent tracers, in color changing media, in solid dye laser, EL laser and in EL devices.